

Transportation GIS Trends

Esri • Fall 2010

GIS for Transportation

Port of Los Angeles Unifies Operations with Data Portal

Comprehensive Access to Data Gives Management Complete Awareness

By Matthew DeMeritt, Esri Writer

Due to the sheer volume of inventory that ships can carry, ports have larger and more complicated infrastructures than most gateways of commerce. Even the physical structure of ports changes over time, with roads and railroads moved, new docks built, and water drained to reclaim land on a regular basis. That dynamic environment recently moved officials at the Port of Los Angeles to consider a complete enterprise geographic information system (GIS) implementation at the harbor—the largest

container port in the United States. In 2009, the Port hired GIS consultant NorthSouth GIS and Esri, as well as engineering firm Moffatt & Nichol and IT consultant Tech/Knowledge, to create a system to aggregate, serve, and share port data throughout all its divisions.

The Main Driver: Unified Operations

The Port of Los Angeles encompasses 7,500 acres; covers 43 miles of waterfront; and features 27 cargo terminals, including dry and

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liquid bulk, container, breakbulk, automobile, and omni facilities. Combined, these terminals handle almost 190 million metric revenue tons of cargo annually. With that amount of goods going through the Port and national security being a primary concern, the first order of business was to give operations, including the Port Police, access to every kilobyte of data related to the Port.

“The initiative to improve data sharing began with the police,” says Christine Thome, enterprise GIS manager at the Port of Los Angeles. “Port Police needed complete situational awareness, and that couldn't be had without a framework to access other divisions' data.” Most of the data was locked up in GIS silos within the department, with no system in place to efficiently serve and share the information throughout the enterprise. Being aware of state-



The Main Channel of the Port of Los Angeles

continued on page 4

On the Road

Esri Partner Conference

March 6–8, 2011
Palm Springs, California USA

ATC Global

March 8–10, 2011
Amsterdam, the Netherlands

Asia Pacific Rail

March 9–11, 2011
Hong Kong, China

Infrastructure Asset Management Exchange

March 21–23, 2011
London, England

AAAE GIS

March 21–24, 2011
San Antonio, Texas USA

GIS-T

March 27–30, 2011
Hershey, Pennsylvania USA

ACI Asia Pacific

April 5–8, 2011
New Delhi, India

UITP Mobility & City Transport Exhibition

April 10–14, 2011
Dubai, United Arab Emirates

Online

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You will find more news and information specific to GIS for the transportation industry in *ArcNews*, a quarterly magazine for the GIS community. Visit esri.com/arcnews.

Talking Transportation



Terry Bills
Esri Industry Manager
Transportation and Logistics

I recently served on a Transportation Research Board (TRB)-sponsored task force assigned to look at the state of practice with respect to GIS-based asset management among state departments of transportation (DOTs). The following thoughts were stimulated by that experience:

Those of us in the GIS community take it for granted that the incorporation of GIS enriches effective asset management practices to the point where we find it difficult to understand how good asset management could be practiced without GIS. In reality, however, most departments of transportation report only limited success in both using good asset management practices and incorporating GIS into their asset management practices. So, why the gap between promise and reality?

First, despite our common beliefs in the power of GIS, I don't think we have effectively demonstrated the inherent advantages of a GIS-based asset management system. Since the original Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, the promise of better transportation infrastructural management and better capital improvement planning inherent in good asset management practice has been understood. Most DOTs have successfully implemented GIS-based pavement and bridge management systems, but the type of integrated cross-asset capital planning envisioned by the act is rare.

This is certainly not due to a lack of software programs or applications that facilitate such cross-asset modeling. Rather, a recent survey of GIS managers at DOTs pointed to the lack of support for and understanding of GIS-based asset management systems on the part of their senior managers. These executive managers need to be convinced of what some of their city-level counterparts have found, that using GIS enhances their ability to manage the information about their assets, visualize the alternatives, and effectively communicate those options to elected decision makers—all leading to better decisions concerning the allocation of scarce public resources.

Furthermore, while better decision making is certainly a good thing, in today's environment we also need to demonstrate to executive managers that the effective use of GIS for asset management will save money. There needs to be a tangible return on investment to justify the expense associated with good asset management practice. The geospatial industry has not effectively demonstrated how GIS can help asset managers save through better and more cost-effective management of existing assets or how GIS can save money by allowing asset managers to better coordinate the timing and scheduling of cross-asset activities. Forward-thinking cities and counties have long recognized how GIS lets them strategically schedule asset maintenance across asset classes to prevent utility repairs on newly resurfaced roadways and other costly noncoordinated maintenance activities.

The promise of GIS-based asset management—an approach that strives to provide the best return on every dollar invested by maximizing system performance and minimizing life cycle costs—is yet to be realized in most state DOTs. We in the GIS community need to do a better job of communicating those benefits, or else this is unlikely to change. I think this edition of *Transportation GIS Trends* will help, so please pass it along to your colleagues and help spread the word.

Terry C. Bills

The Roads & Highway Resource Center

The Roads & Highways Resource Center is a place where you can find maps and apps to help you implement ArcGIS. They are organized around road and highway safety and maintenance activities and will help you manage your geographic information, visualize trends, and publish great maps.

This Resource Center is also a place where you can communicate with other road and highway users, business partners, and the teams within Esri supporting the transportation community. When you join this community, you can collaborate with us on the ArcGIS maps, apps, and best practices for road and highway maintenance.

To learn more, go to the ArcGIS Resource Center at resources.arcgis.com.



Case Studies Wanted

Share the benefits of your GIS work with colleagues by submitting case studies for future issues of this newsletter. Case study articles can be a full page or half page, up to 800 words. We also like to include high-resolution screen shots or photography with the articles. To submit a case study article, contact Marshall Cammack at mcammack@esri.com or Terry Bills at tbills@esri.com.

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Developers to Meet Up at Regional Events

Developers at all levels of expertise who are interested in geospatial technology are invited to attend regional Dev Meet Ups scheduled to take place between now and May 2011. These free events will give you the opportunity to demonstrate your application or framework, present an interesting concept or idea, share your experiences, and connect with other developers. For more information or to register for a Dev Meet Up close to you, go to esri.com/devmeetup.

State	City	Date	Status
NY	New York	Thursday, June 24, 2010	Who attended
CA	Los Angeles	Wednesday, November 10, 2010	Who attended
IL	Chicago	Thursday, September 24, 2010	Who attended
	Washington, DC	Monday, September 28, 2010	Who attended
PA	Pittsburgh	Thursday, September 24, 2010	Who attended
TX	Austin	Wednesday, October 13, 2010	Who attended
TX	Dallas	Thursday, October 14, 2010	Who attended
NC	Charlotte	Thursday, October 14, 2010	Who attended
IN	Indianapolis	Wednesday, October 20, 2010	Who attended
CO	Fort Collins	Wednesday, October 20, 2010	Who attended
NC	Raleigh	Thursday, October 21, 2010	Who attended
CO	Denver	Monday, October 25, 2010	Who attended
UT	Salt Lake City	Monday, November 8, 2010	Coming soon
FL	Fort Lauderdale	Tuesday, November 20, 2010	Coming soon
CA	Mountain Empire	Wednesday, December 1, 2010	Coming soon
TX	San Antonio	Wednesday, December 1, 2010	Coming soon
CA	San Diego	Thursday, December 2, 2010	Coming soon
FL	Tampa	Thursday, December 2, 2010	Coming soon
TX	Houston	Thursday, December 2, 2010	Coming soon
WA	Seattle	Wednesday, December 8, 2010	Coming soon
WA	Seattle	Wednesday, December 8, 2010	Coming soon
CA	San Jose	Thursday, December 9, 2010	Coming soon
CA	Sacramento	January 2011	Coming soon
CA	San Francisco	January 2011	Coming soon
CA	San Jose	January 2011	Coming soon

Port of Los Angeles Unifies Operations with Data Portal

of-the-art business technology, the IT division knew that an array of GIS servers combined with API software would easily allow police to mine whatever data they needed at any time.

“Optimizing the way our Port Police division makes decisions about where to dispatch officers was a top goal,” says Thome. “We knew that an ArcGIS Server software-based system would do that, as well as provide a foundation for a robust Blue Force Tracking system that shows where all officers, vehicles, and vessels are at any given time.” The success of the project convinced management and the rest of the divisions that actively shared their data with Port Police that an enterprise GIS implementation would work for all Port operations.

“Optimizing the way our Port Police division makes decisions about where to dispatch officers was a top goal.”

Christine Thome, Enterprise GIS Manager at the Port of Los Angeles

Since Port Police has sensitive data that only security personnel can manage and view, data permissions for each division needed to be sorted out first. Every division that owns and maintains data for the Port of Los Angeles has permissions for updating and making changes to its datasets, but the security rights given to each layer depend on who has permissions to view and update that data. “We formed a technical advisory committee for that,” says Daniel Elroi, president of NorthSouth GIS. “This was one of the many steps we took to encourage collaboration by making it possible for divisions to retain control over their data.”

Data Portal: geoPOLA

A significant portion of data at the Port of Los

Angeles is dynamic information, not just static points, lines, and polygons. Constantly in flux, dynamic data, such as ship locations, weather, and movable assets, is just as crucial to know as fixed geospatial parameters. Without access to that information, complete maritime domain awareness (nautical speak for common operating picture) wasn't possible.

“We created a viewer with the Silverlight API that would display all enterprise data, including the dynamic data,” says Elroi. “Port data changes frequently in location, status, or both. The key to delivering optimal awareness across the board was to write software that combined static and dynamic awareness in one area for everyone to view.”

Port of Los Angeles staff members view data exclusively through the browser-based Silverlight viewer, which it calls geoPOLA. Users have praised the viewer for its ease of use, its outstanding performance, and its ability to show each division at the Port the data



The geoPOLA application was created with the ArcGIS API for Microsoft Silverlight.

layers of greatest relevance to its own members. The Port's GIS editors, who maintain the ArcGIS Server enterprise geodatabase with both AutoCAD and ArcGIS, also appreciate that the same map services used in geoPOLA are available in their desktop software when working on their GIS data.

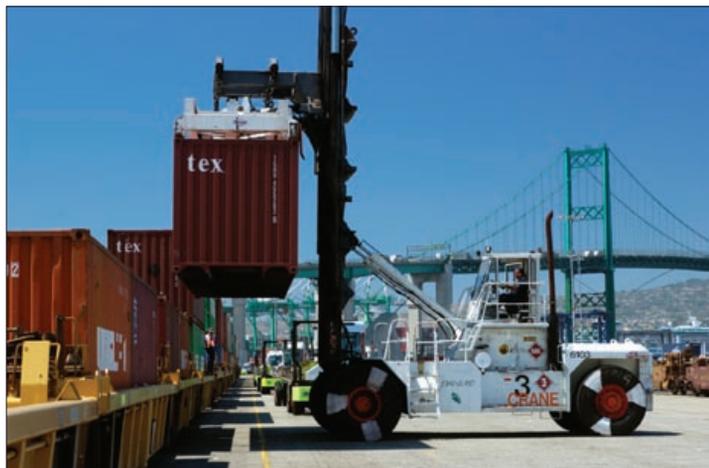
Feeds and Metadata

One of the most important aspects of a modern GIS implementation is the integration of data from disparate sources. "We needed to carefully research which feeds we would connect to the enterprise viewer," says Thome. "We knew there were good feeds out there but also ones that wouldn't deliver the kind of information

we needed." That process involved the creation of a Dynamic Data Focus Group that met and determined what type of dynamic data the Port could consume. The Dynamic Data Focus Group and NorthSouth GIS researched different sources of data to see if they had anything that the Port could consume as a feed. After three months of research, they finally chose the feeds that delivered the kind of tangible information the Port could use. The final feeds they decided on were the Vessels, Radar, AVL, Weather, Traffic, and CHP Alerts. The system is also designed so that new dynamic feeds can easily be added through a data feed middleware that converts various formats into a standardized GeoRSS format.

Almost as important as dynamic data integration is the creation of metadata standards and procedures. For that, Elroi customized a metadata program that simplified the creation, tracking, and management of the Port's finer-grained data. "That program was invaluable in helping us set up our standards and procedures for capturing metadata," says Thome. "Without it, inputting this information manually would have taken forever."

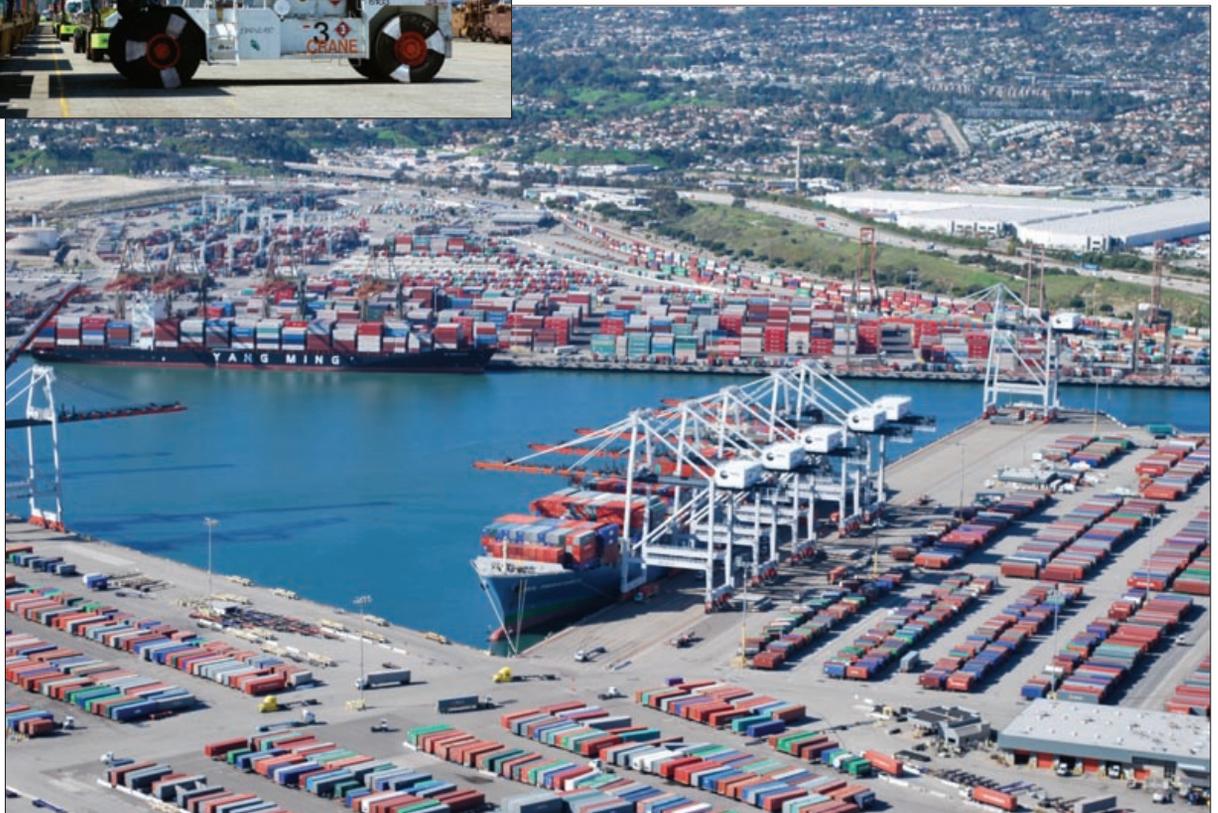
As the nation's premier trade gateway, the Port of Los Angeles needed to fortify its internal operations to remain efficient and profitable. That fortification resulted in more than 1,000 computer users at the Port easily accessing GIS and dynamic data through geoPOLA. Thanks to that newly reinforced infrastructure, one of America's busiest ports will remain competitive for years to come.



Asset information for equipment, such as this cargo loader, can be displayed in the geoPOLA viewer.

For more information, contact Christine Thome, Port of Los Angeles enterprise GIS manager (e-mail: cthome@portla.org).

The port handles 190 million metric tons of cargo annually.



Managing ADA Sidewalk Compliance

Maryland SHA's Web Portal Improves Business Processes and Decision Support

By Emily Pierce, Esri Writer

Access to government services is a right for all citizens of the United States. To ensure that those with disabilities have an equal opportunity to benefit from state and local government programs, services, and activities, Title II of the Americans with Disabilities Act (ADA) requires that state and local governments make programs and services accessible to persons with disabilities such as wheelchair access to sidewalks. To accurately assess and improve compliance of sidewalks along Maryland state routes and highways, the Maryland State Highway Administration (SHA) turned to GIS to improve business processes and make data available to decision makers. With a well-thought-out plan, SHA was able to complete data collection in eight months.

"We started collecting the data in 2006, but before that, we needed to figure out exactly what data we were going to collect, how we were going to collect it, and how we could do it

efficiently," said Norie Calvert, deputy director for the Office of Highway Development. "We really had to think long and hard about how we could do it in a way that made sense and wouldn't be too costly."

SHA gathered data along nearly 900 miles of state roadways. Six temporary staff members working in pairs collected data via Trimble GeoXH handhelds that had a customized application built with Trimble GPS Pathfinder Office software. Staff collected data on sidewalks, ramps, driveway crossings, medians, bus stops, and obstacles such as utility poles.

To make data collection more efficient, SHA used pull-down menus. For example, sidewalk cross slope is a feature that is measured to determine accessibility; the maximum cross slope for accessibility is 2 percent. Instead of recording the actual cross slope, data collectors simply chose "yes" or "no" to record compliance. Another example

is the width requirement; a sidewalk either met minimum width requirements or it did not. "You don't need the actual measurements to make a decision," noted Calvert. Simplifying the process allowed SHA to quickly collect the data it needed and begin to focus on improvements. ArcSDE technology is being used to manage the data, which is shared via an ArcIMS software-based ADA Portal application.

A state measure requires that the amount of sidewalk compliance increase by 2 percent each year, and the budget for sidewalk improvements supports this pace. Staff members are now able to track that data and the progress of the program through the ADA Portal. As of August 2008, 54 percent of SHA's 900 miles of sidewalks were compliant. This is an increase of 5 percent since the initial data collection in September 2006.

The intention behind the application is not only to measure SHA's performance in improving facilities but also to guide the sidewalk improvement program so it focuses improvements where the need is most significant and uses funding for the greatest benefit.

Better Business Processes

"Redefining business processes to make them more efficient was the biggest challenge in this GIS project," explained Gregory Slater, chief of the Design Technical Services Division at SHA. There are seven SHA district offices and several divisions within SHA that were overseeing various aspects of ADA compliance, and all were working independently. Now, SHA has a group in the Innovative Contracting Division that is the single point of contact and manages data updates. Once business processes were streamlined, the second component, IT, could be developed to support the new processes.

"What we really did was allow the GIS to provide enhanced decision support," noted Slater. "The GIS manages the data but also steers us. We have a dashboard where we can

"We can look at where we have existing capital projects already in place, and we can tie sidewalk improvements to those existing projects to streamline our approach to maximize our dollars."

Gregory Slater, chief of the Design Technical Services Division at SHA



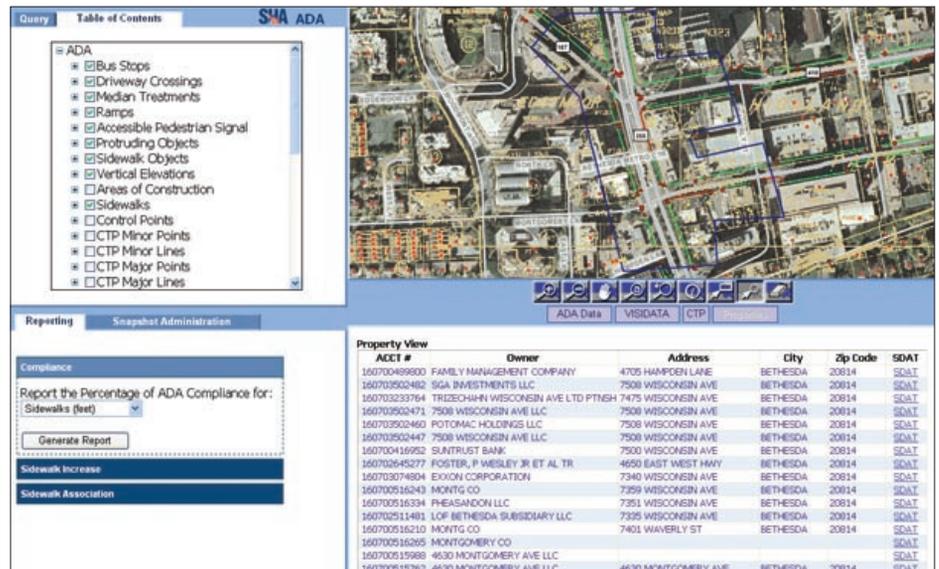
Within the ADA Portal, users can click on a point in the map to view SHA video of that section of roadway.

report the success of the program statistically, but then we also have what I call a steering wheel that goes with the dashboard, which are the components built into the GIS.” The components Slater refers to include data from Maryland Department of Transportation’s (MDOT) consolidated transportation plan that allows SHA to see where sidewalk facilities are in relation to capital improvement projects. “We can look at where we have existing capital projects already in place, and we can tie sidewalk improvements to those existing projects to streamline our approach to maximize our dollars,” Slater explained.

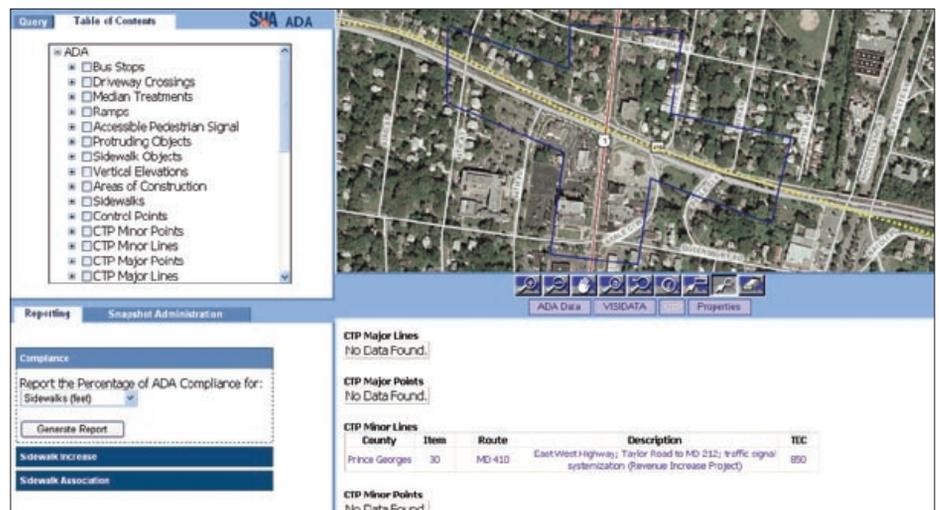
The GIS is also linked to the State Department of Assessments and Taxation database, so SHA can see data on property ownership and values. This helps SHA determine right-of-way issues that arise. “By consolidating our efforts, we get the most out of our money,” Slater added.

GIS has also helped SHA identify areas with high pedestrian traffic. Data on pedestrian volumes and pedestrian accidents is utilized in the GIS and improves prioritization of sidewalk improvement projects. “We are able to prioritize where our greatest needs are, based on pedestrian incidents; community feedback; and the proximity to heavy pedestrian centers like government facilities, shopping centers, and mass transit,” Slater added.

In addition to maps and aerial imagery, the ADA Portal links to a video log SHA gathers once a year from crews that drive the state roadways. This video’s original purpose was to enhance monitoring of pavement condition and support decisions about resurfacing projects. Now SHA links mileage points in the video to coordinates in the ADA Portal to see the condition of sidewalks along state roads. In the portal, SHA is able to access the video log at the current location being analyzed and see the ground-level shots along with the sidewalk data and the aerial photography views.



The ADA Portal links directly to the property database from the State Department of Assessments and Taxation for the most up-to-date information. This image shows a list of potential property impacts and provides a rough assessment of how far SHA rights-of-way extend beyond the road. With this information, SHA can assess the impacts of sidewalk improvements in this area.



The ADA Portal shows where existing projects are in MDOT’s consolidated transportation plan so sidewalk improvements can be tied into existing improvement projects. This image shows a location slated for a traffic signal system improvement.

Citizen Participation

In the end, the purpose of sidewalk improvement projects is to better serve communities and taxpayers. To gather citizen input, SHA representatives meet with members of the disabled community on a regular basis to gain insights into their needs. Another public outreach initiative involves sending SHA staff into each of Maryland’s 23 counties to hold public meetings. At these gatherings, SHA staff members present the self-assessment project, explain the status of improvements, and give community members an opportunity to share their ideas.

Eventually, there will be a public-facing Web site. SHA is currently working on developing

a site that will be accessible to those with disabilities.

To achieve success with a project like this, Slater pointed out, “You can’t be intimidated by measuring performance and statistics. You have to be willing to do it openly to be able to improve it, and what we did was build a system where we can openly measure the performance of this program and guide the direction of the sidewalk improvements.”

For more information, contact Gregory Slater, chief of Design Technical Services Division, State Highway Administration (e-mail: gslater@sha.state).

Werner Enterprises Takes Delivery of Improved Asset Management and Route Planning

By Karen Richardson, Esri Writer

A few years ago, Werner Enterprises, Inc., one of the five largest truckload carriers in the United States, realized that seeing is everything. A stretch of Interstate 80 in Iowa flooded and completely shut down the road. Werner needed to find out which trucks in its fleet were facing being diverted, since the drivers would need to avoid the closed portion of freeway, incurring out-of-route mileage.

“At the time, there was no way for us to see specifically which trucks were affected,” says Scott Andersen, manager of logistics analysis and GIS at Werner. “The best we could do was find trucks, one at a time, that might have traveled between Omaha, Nebraska, and Chicago, Illinois, at some point in time. This is not an easy task when you are sifting through drive records for 9,000 trucks.”

Two weeks later, Werner’s employees found the information, but by then, it was too late. “We didn’t recoup any of our costs,” says Andersen. This was an eye-opener for the company, and Werner wasted no time in finding a technology that could help it see its trucks on the road at all times, before the next business interruption occurred.

Today, GIS technology from Esri helps Werner keep track of its vast fleet. Using ArcGIS and a trailer tracking device traditionally used by long-haul truck companies, Werner

can now bill mileage to customers more accurately and route its fleet more efficiently.

A Vision for GIS

Every day, a fleet of thousands of Werner 18-wheel trucks and their drivers are on the move, delivering food, beverages, manufactured goods, and other freight across the United States.

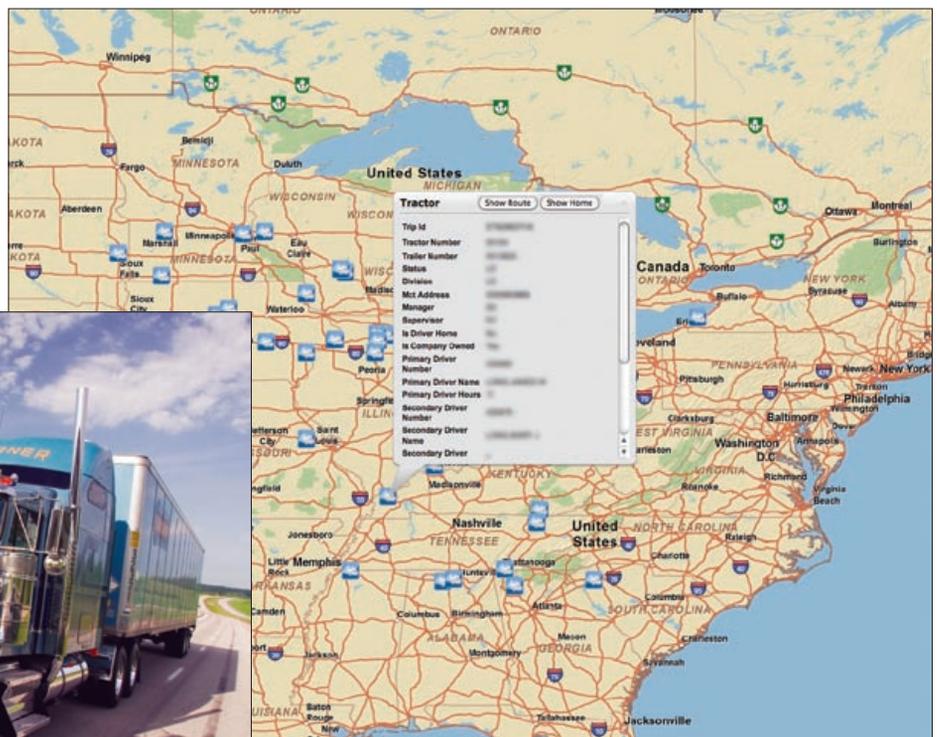
While Werner uses a traditional tracking device tied to communication networks to deliver information about trucks that are out on the road back to the main office, it could not visually see where they were located. Displaying the trucks’ specific locations, along with the locations of preferred fuel stops, maintenance facilities, and Werner properties, on a map that shows up-to-the-minute information is very useful, making it easier to better manage such a vast inventory of trucks.

Anthony DeCanti, vice president of Werner, understood that organizations running fixed

assets like the large transportation fleet at Werner need to carefully manage business costs. Knowing where trucks are located allows the company to be prepared for anything: inclement weather, a load change, or a broken-down vehicle. DeCanti knew about GIS technology and understood that using GIS software to see exact locations of Werner’s trucks could help the company take advantage of shorter routes, plan fuel stops more accurately, and find the nearest stops when needed.

DeCanti directed Werner’s IT department to research available GIS solutions, and after looking at many options, the company adopted Esri GIS technology six years ago. “We felt there wasn’t a better solution out there for managing the large amount of information we had to manage, and we were able to integrate GIS into our existing core business processes,” says Andersen.

continued on page 10



Using ArcGIS technology, Werner can see where the company’s trucks are located anywhere and at any time.

Where Business Finds Direction



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These three products are now included in the Esri StreetMap® Premium Advanced product (www.esri.com/streetmap)

Werner Enterprises Takes Delivery of Improved Asset Management and Route Planning

Putting Werner in the Driver's Seat

Werner implemented Esri's ArcGIS, a software platform used to integrate geographic location into business data, to better manage information. Werner uses the software to keep track of the company's fleet of 9,000 18-wheel trucks.

Trucks are outfitted with a transmitter that provides two-way text and data communications between the trucks and Werner's headquarters. Part of the data is the latitude and longitude coordinates of the trucks' locations. When transmitted back to the main office, the latitude-longitude is geocoded, and the locations of the trucks can be seen on interactive maps using ArcGIS Desktop.

Having access to this information and being able to respond to changes in operation are imperative for running a transportation and logistics business. There is little room for error, and being agile, thanks to better access to information, helps the company run profitably and deliver superior performance to customers.

Seeing where the trucks are located allows Werner to run reports that calculate geographically based information, such as mileage, how much of a load a truck can carry to a specific destination, and where drivers need to stop for such things as refueling or deliveries. The capability to access this information and ask questions of the data allows Werner staff to run different scenarios and find the best solution that will save the company time and money and keep drivers safe. Werner can now run its business using its trucks and drivers in smarter ways and reducing costs.

Keeping the Business Running

When a rockslide affected North Carolina's Interstate 40, Werner was ready. With ArcGIS, the company displayed the information it needed on a map instead of looking through reams of records by hand. Staff used ArcGIS to find and identify the trucks that had historically passed the particular road segment affected by the slide. This information was then cross-checked with the trucks that were actually out on the road at the time as determined by real-time data received by the trucks' transmitters;



When a rockslide occurred in North Carolina and closed a portion of Interstate 40, Werner staff was able to see all the routes feeding into that section of freeway and find the trucks affected by the closure.

then hundreds of customers were notified of the disruption in service as well as any charge that would be incurred because of additional mileage. This process only took the company a few days to complete.

"We went from not being able to identify the trucks that were affected to having more than 90 percent accuracy," says Andersen. "There was no way we could have done that before. And to top it off, the analysis was very fast."

Today, data is readily available by clicking on a truck icon on the map, including where the truck is heading, the driver's name, the hours or road time he or she has, and what type of freight is being carried. To be able to see this information quickly is important for scheduling the trucks and drivers and ensuring that drivers are not given too many drive hours, the trucks go in for on-time scheduled maintenance, and the routes are optimized. Andersen says that consolidating all aspects of on-road operations into the visual and intuitive GIS environment has significantly streamlined Werner's workflows. "By knowing exactly where our assets are at a given time and comparing that to the origins and destinations of loads we have in our pipeline, we can better allocate our resources and truly understand the costs of doing business," he says.

The company is upgrading from ArcGIS Server 9.3.1 to ArcGIS Server 10, integrating GIS data and maps more completely into its enterprise workflow. Werner chose to implement GIS over the Internet so data could be easily shared throughout the organization using standard Web browsers to access the maps and data. Web applications will be used by dispatchers and driver managers.

While Werner initially used GIS to gain better insight into fleet operations, today the company uses ArcGIS in many areas of its organization. Having spatially enabled its fleet for display on a map, Werner is further leveraging the analytic power of GIS. Analyzing logistics and performing common geospatial services throughout the enterprise, such as geocoding, finding the closest important location, and generating and summarizing data within drive-time buffer areas, are all activities the company can do with GIS.

For more information on how GIS helps logistics and other companies manage their fleets, visit esri.com/logistics.

A map of New York State is shown in the background, with various counties labeled. Overlaid on the map are numerous orange circles of varying sizes, representing data points or locations. The Citrix and ESRI logos are positioned at the top of the map, above the main title.

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Airports around the World Discover the Power of GIS

By Terry Bills, Esri Industry Manager, Transportation and Logistics

Managing a modern airport is a complex business. As some of the most heavily utilized transportation facilities, airports need to operate at high levels of performance at all times. In this context, airport managers have to respond to a wide range of challenges: sustainability, security, regulatory and environmental compliance, and operational efficiency, all while trying to hold down costs in a highly variable market. As a result, an increasing number of airports around the world have turned to GIS to help them manage these complexities.

Why GIS?

GIS combines a variety of spatial information—accurate digital orthophotos and maps of airport layouts, facilities, infrastructure, and utilities—linked information about those assets. GIS helps airport operators visualize all their assets, whether those assets are

GIS helps airport operators visualize all their assets, whether those assets are terminal facilities, leasehold, runway lighting and signs, or subsurface utilities.

terminal facilities, leasehold, runway lighting and signs, or subsurface utilities.

By helping visualize all these assets, GIS gives airport managers a common operational picture of all their facilities and thus greater power to effectively control operations. This is true whether the task at hand is providing security, performing inspection and maintenance activities, or knowing where all the luggage tugs are currently located.

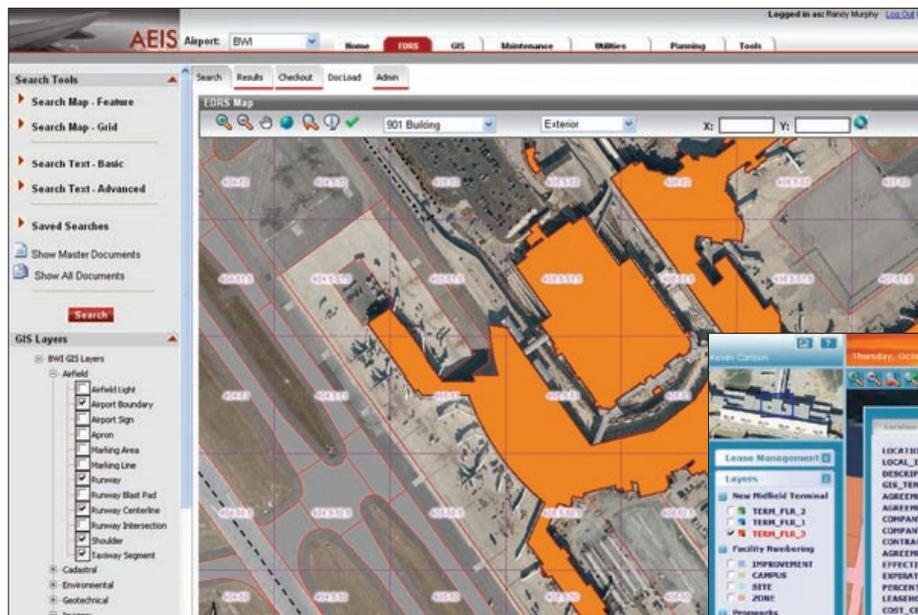
Finally, GIS helps facilitate the integration of an airport's various information systems, providing a platform that enables greater operational efficiencies. The world's leading airports incorporate GIS into the center of their enterprise information systems, allowing them to mine those information systems for better decision making.

Return on investment studies conducted at Los Angeles International Airport by AECOM,

one of the leading airport GIS providers, demonstrated that after an initial investment in establishing a GIS, the system delivered an annual return in excess of 400 percent. This study did not consider the financial advantages of being able to visualize all airport assets but rather focused primarily on specific savings associated with the capital improvement process, reduced change orders, and greater lease billing recapture.

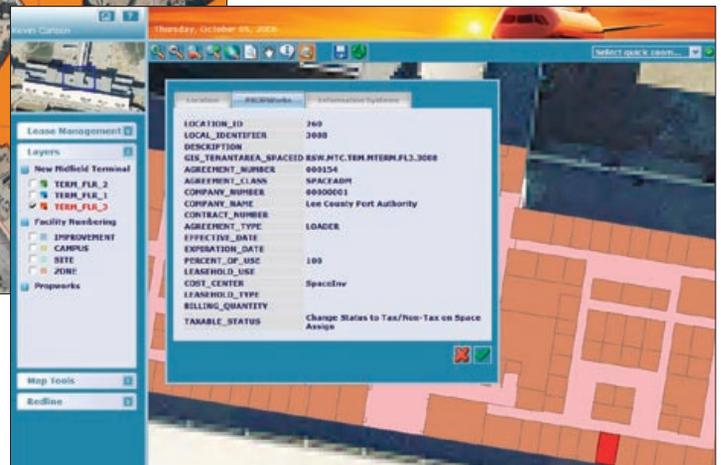
Environmental Compliance

One of the early uses of GIS within airports is often for noise and obstruction analysis. GIS is well suited not only for modeling noise



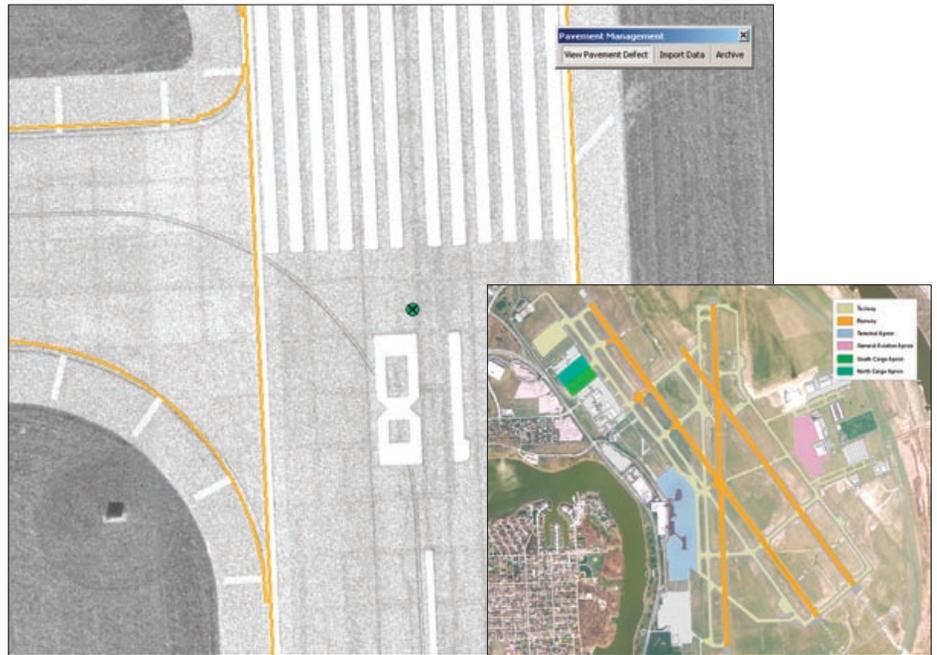
Baltimore-Washington International Thurgood Marshall Airport's GIS-based Engineering Document Retrieval System offers map and airport grid-based document searches.

An enterprise GIS is integrated with an airport property management system at Southwest Florida International Airport.



contours but also for overlaying those contours on detailed maps of the affected populated areas to determine the extent of exposure. This analysis often becomes the baseline for subsequent mitigation efforts, and property-level mitigation activities can also be cataloged and visualized through GIS. A number of airports take this one step farther and use GIS to link individual noise complaints back to the individual flight track based on the time of the complaint and the time-stamped flight track.

The January 2009 crash of US Airways Flight 1549 into the Hudson River highlighted the importance of conducting wildlife hazard assessments and developing a Wildlife Hazard



A mobile GIS solution allows Eppley Airfield in Omaha Nebraska to map and document runway surface defects.



Gimpo International Airport near Seoul, South Korea relies on a Web-based safety management system to help move its vehicles and airplanes. Powered by ArcGIS Server, the solution allows airport officials to share information on moving objects in real-time.

Management Plan for all airports. A large number of airports use GIS to catalog their wildlife surveys and counts and document their airfield vegetation maintenance activities. Dividing the airport land into a grid system, bird and other wildlife counts can be collected and entered in the field with mobile GIS, alerting airport managers to areas of greatest wildlife concentration. In addition, all bird strikes are

accurately located and reported to the civil aviation authorities for further analysis.

The ability to incorporate light detection and ranging (lidar), digital elevation, and survey data into a three-dimensional space makes GIS the optimal way to conduct terrain and obstacle analysis around the terminal control area and airfield. Typical flight path, approach, and transition zones can be visualized, and

required permitting systems can be designed from such GIS-based information. The same three-dimensional analysis can be applied to radio quality and VHF omnidirectional radio range (VOR) coverage gap analysis surrounding the terminal control area.

Terminal Side Systems

The second wave of GIS applications involves moving the system into the terminal. By digitizing the interior space of the terminal with a high degree of accuracy, such as with 3D, airport managers can use this information to support a number of operational systems. Facilities, lease, maintenance, and security management systems each depend on the same base data but apply it for different purposes.

With the GIS at Spain's Madrid-Barajas Airport, managers can see each of the leasehold within the terminal and its revenue consequence. Developed by Indra, a Spanish technology systems company, the automated lease

A large number of airports use GIS to catalog their wildlife surveys and counts and document their airfield vegetation maintenance activities.

management system allows active management of the airport properties to the greatest advantage. In addition, passenger counts are taken at various locations throughout the airport

to determine the rates for interior advertising signs, all effectively managed within the GIS.

Phoenix Sky Harbor International Airport not only utilizes digital coverage of all its buildings for facilities management but also links the same data to its SAP maintenance management system. The system keeps track of all work orders and maintenance activities within the terminal and on the air side as well. The airport also integrates its lease management system (Propworks) with the GIS, helping track all terminal-side costs back to its tenants.

A number of other airports integrate their Maximo maintenance management systems with GIS, helping them track all outstanding

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Airports around the World Discover the Power of GIS

work orders and capture all maintenance activities over time. GIS can also integrate with document and records management systems, allowing airport managers easy access to original design drawings from CAD, as well as more traditional documents, directly from the GIS interface. Some airports, such as Hong Kong's Air Cargo Airport, are now beginning to use GIS together with radio-frequency identification (RFID) technology for better baggage and package tracking and handling.

Air Side Applications

Most airports carry their maintenance management systems to the air side, with GIS information often used for daily inspections, work orders, and the more traditional pavement management systems. Being able to accurately capture and locate pavement distress, condition of runway lighting, signs, and markings by integrating them into a GIS-based maintenance management system removes guesswork. It also helps airport maintenance managers accurately understand and manage all their facilities and assets.

Combining both air and terminal operations, a number of airports have captured their subsurface utilities and their communications and IT cabling networks. Because GIS supports not only a real-world view but also a schematic presentation of the same information,

network engineers and maintenance managers can share the same data presented in a different manner for different requirements. The advantages of storing this information in a GIS include the ability to perform downstream network tracing for water, waste, and contaminant spill management. The ability to quickly and accurately locate a valve in real time can help establish a strong ROI for a GIS system.

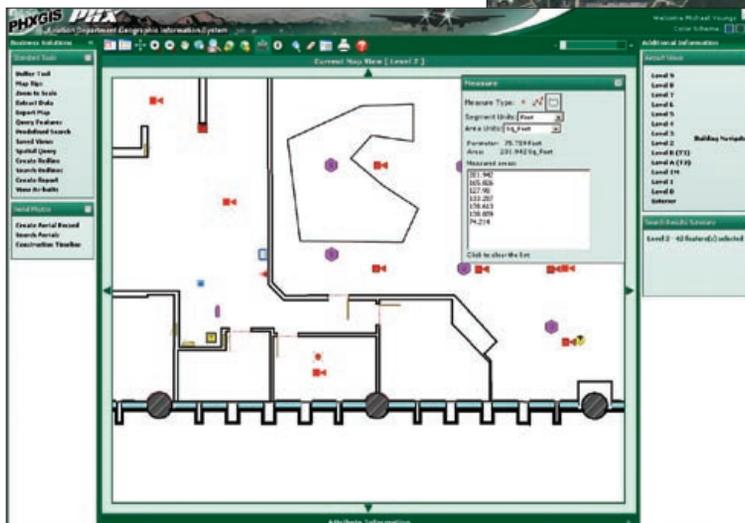
As airports become more and more congested, many airport operators are looking to integrated technologies to help them achieve greater capacity throughout their existing facilities. This has inevitably led to equipping movable assets, such as luggage tugs and fuel trucks, with GPS and monitoring these vehicles—along with planes—in real time through a GIS. Several German airports are experimenting with such real-time operational systems designed to optimize the operational efficiency of all ground support activities with the goal of reducing ground-based flight

delays. As capacity issues continue to be problematic at many airports, such approaches will become necessary.

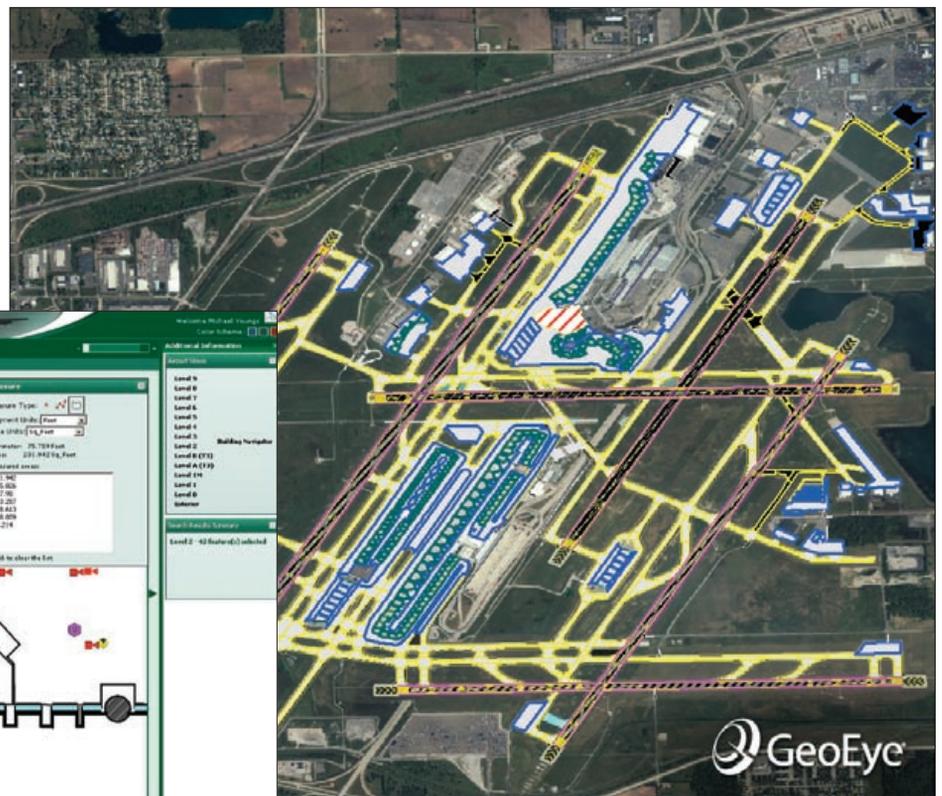
Finally, the visualization capabilities of GIS are uniquely positioned to help airport security and safety managers gain a common operational view of the entire airport. With the ability to integrate such technologies as closed-circuit television (CCTV), real-time asset tracking and monitoring, and badge tracking for airport personnel security systems, GIS has become an integral part of many airport security and emergency command centers.

These are just a few of the many ways that airport managers have implemented GIS technology to help them better manage their operations, giving them a competitive advantage in turbulent times.

For more information, contact Terry Bills, Esri industry manager, transportation and logistics (e-mail: tbills@esri.com).



Personnel at Arizona's Phoenix Sky Harbor International Airport can review interior floor plans and calculate area and perimeter with a measurement tool available through the facility's GIS portal.



An Airport Mapping Database (AMDB) shows an expanded view of Detroit Metropolitan Wayne County Airport in Michigan.

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New York State's Road Status and Damage Assessment Tool Enhances Emergency Operations

New York State comprises 62 counties and more than 114,000 miles of public highways and roads. Geography varies widely across the state. The New York City metropolitan area dominates the downstate region of New York, and other large cities are spread across the state including Albany, Buffalo, Rochester, and Syracuse. The Adirondack and Catskill regions are covered with mountain peaks and lush forests. Much of the remaining area of New York, including the Central Finger Lakes and Western New York, is largely rural and dotted with small communities, farms, and wineries.

The New York State Department of Transportation (NYSDOT) is responsible for more than 15,000 miles of state-owned roads—which vary from divided multilane interstate expressways to two-lane roads in rural areas—as well as all 20,000 bridges in the

state. When a weather event or other incident that has a major impact on the highway system of one or more New York State counties forces the governor to declare a state of emergency, NYSDOT resources are activated to assist in assessing and repairing damage to all public highways, including local streets, in those counties.

During emergencies, it is critical for NYSDOT to be able to collect and report current road status and damage assessments in a consistent and timely manner. This information enables NYSDOT supervisors and managers to deploy their limited department resources most effectively. In addition, NYSDOT has a responsibility to provide current road status information and report on the progress of response activities.

For many years and through 2007, NYSDOT used its now legacy GIS tools to assist with

emergency response. Since the mid-1990s, one GIS application, called the Emergency Road Status Tool, had been used in the field by assessment teams to report the current status of the highway network using shapefiles. The system was simple to use and effective for the most common events in the Northeast, such as severe snowstorms. Then, when widespread flooding hit New York in June 2006, NYSDOT quickly developed a server-based application called the Damage Assessment Reporting System (DARS). DARS provided assessment teams with a browser-based form to enter detailed reports on damaged highway infrastructure, including the feature (e.g., culvert, bridge, pavement), location, type of damage (e.g., culvert plugged, culvert washed out), and other related information. An Internet management service provided an operational map of assessments collected with DARS.

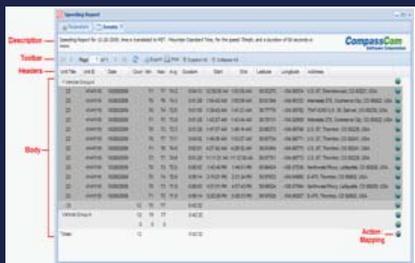
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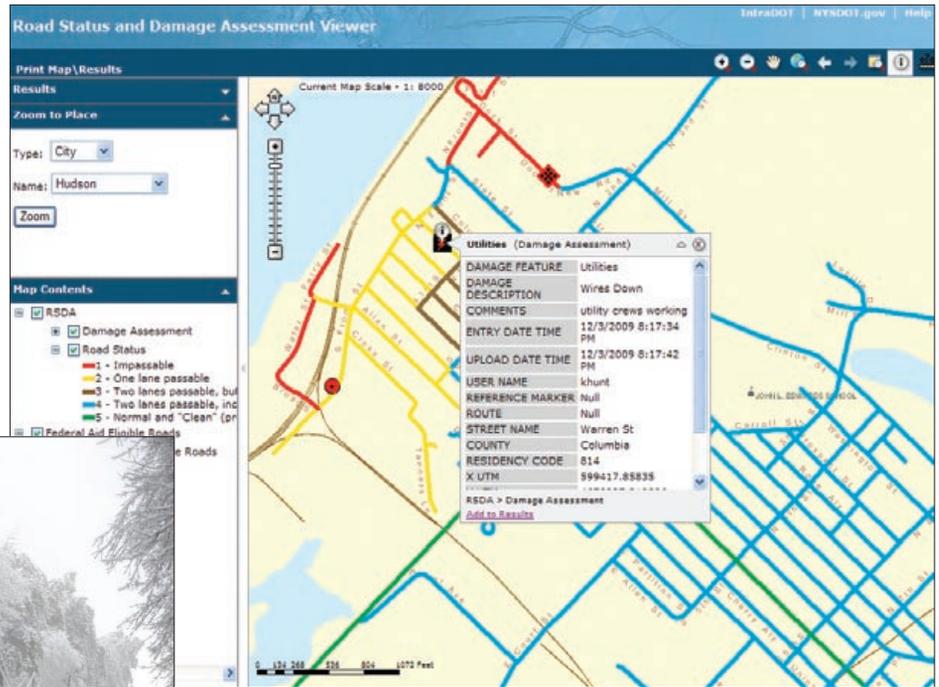
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Each of these systems quickly highlighted the shortcomings of the other. The Emergency Road Status Tool did not have the functionality to collect detailed damage assessments and required too much time and effort to transmit reports to the main office, while DARS lacked

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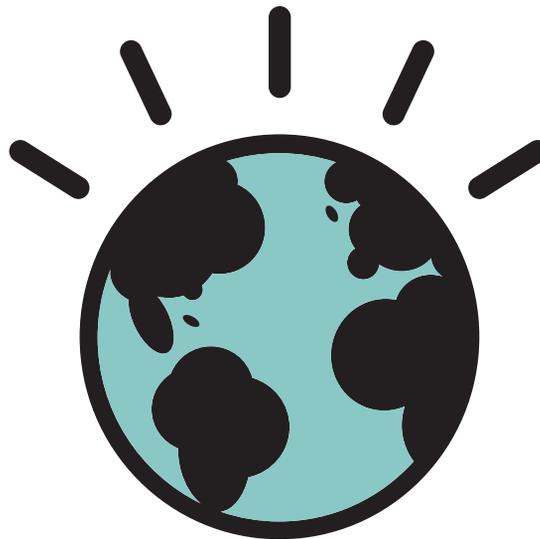


Weather can seriously affect New York State road conditions. NYSDOT's GIS-based RSDA system helps get work crews and roadways up to speed.

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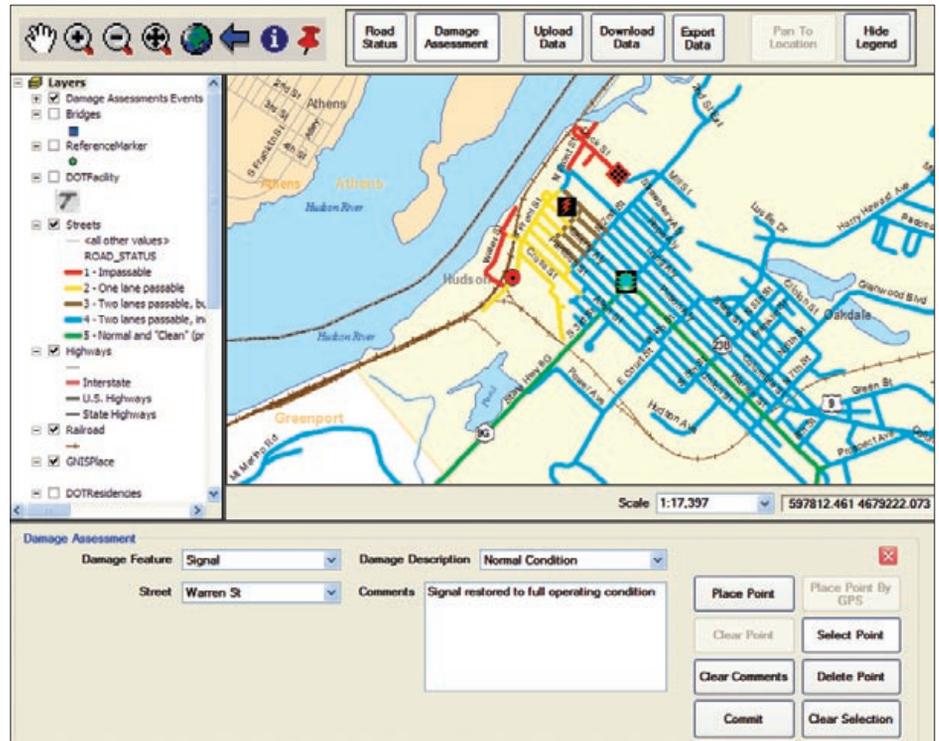
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New York State's Road Status and Damage Assessment Tool Enhances Emergency Operations

the more intuitive map-based interface for data entry and required an internal network connection. Assessment teams that could not connect to the Internet would not have direct access to the application.

In late 2007, NYSDOT's GIS group began work with Esri partner Fountains Spatial, a GIS consultant in Schenectady, New York, to develop the Road Status/Damage Assessment (RSDA) system. The RSDA would be a single GIS-based application that would improve on the functionality of the legacy systems to fully meet the department's emergency data collection requirements. As a foundation technology for the application, NYSDOT and Fountains Spatial quickly settled on the ArcGIS Engine development environment to fully leverage ArcObjects and the geodatabase.

The primary component of the Road Status/Damage Assessment system is the field tool. The user interface includes the map, basic navigation tools, and separate interfaces for coding road status on the street network and point-located damage assessments. The RSDA field tool allows assessment teams to compile road status and damage information in a local file geodatabase without a network or Internet connection. The contents of the pull-down menus are based on domains in the RSDA



New York State DOT's ArcGIS Server environment provides complete road status and damage assessment information to emergency operations staff in its main office, regional office, and Emergency Operations Center.

geodatabase, so adding a new damage type to the application requires a simple geodatabase change rather than code changes. The field tool is also capable of using GPS coordinates to find current or place new damage assessment locations.

A major goal for the project was to minimize the lag time between obtaining a report in the field and providing that report to decision makers in the command centers. The development team accomplished this by providing communication between the RSDA field tool and an enterprise ArcSDE version of the geodatabase. When an NYSDOT network connection is available (through a field office or secure VPN), RSDA will transfer new and revised reports to the enterprise geodatabase using the Upload tool. This capability greatly improves reporting speed.

The first true test of the Road Status/Damage Assessment tool came in December 2008 when an ice storm severely crippled New York's Capital District and surrounding areas. Columbia County was hit especially hard, with downed trees and power lines effectively shutting down much of the state and local highway system. The Emergency Operations Center (EOC) began sending out assessment teams with RSDA on Sunday, December 14, 2008. Comprehensive information on the status of the highway system and detailed



damage assessments were uploaded to the enterprise geodatabase, and the road status was continually updated during the week. Decision makers in the main office incident command center and the local EOC could easily view this information in the ArcGIS Server software-based RSDA Viewer.

The NYSDOT Emergency Operations Center used information collected by RSDA to prioritize repair and cleanup work. The map-based view of damage assessments provided crews with a view of problems nearby, allowing more work to be accomplished on a single trip. The RSDA Viewer was provided (via Citrix) to Columbia County's Emergency Operations Center, and by using the same operational picture at both locations, the state and county were better able to coordinate their response activities.

RSDA reports also allowed NYSDOT to communicate the condition of the highway system to emergency services, utility providers, and

the community. For example, the EOC helped school superintendents make decisions on school closings by providing summaries of road closures and conditions for each school district.

After the event, emergency operations staff gave RSDA high marks for assisting in the emergency response efforts. The EOC reported that new teams with no RSDA or GIS experience had a working familiarity with the application with just 5–10 minutes of instruction. Almost 100 damage assessments and road status updates for every public road in Columbia County were successfully uploaded to the enterprise database.

Much of the success of the RSDA implementation may be credited to the iterative development process. Samples of the user interface were built in the first three weeks, enabling the team to make good early decisions about workflow and usability. A few weeks later, a prototype was provided to a pilot group of individuals responsible for emergency

operations for their comments and feedback and incorporation into subsequent development. Before a final version of the tool was accepted and deployed, NYSDOT's Emergency Operations Center used a prerelease version of RSDA in a full-scale, statewide drill. Again, the project team evaluated and incorporated comments from the user community in the final version.

Developing applications for emergency response is a special challenge. The system must be easy to deploy and use and work as designed under difficult circumstances. The response to the ice storm demonstrated that NYSDOT achieved its goals for the Road Status/Damage Assessment system. Use of GIS technologies was key in meeting these goals.

For more information, contact Kevin Hunt, GISP, NYSDOT GIS manager (e-mail: khunt@dot.state.ny.us).



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